The American Biology Teacher

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Field Study to Challenge

Biology Crossword Puzzle

Index for Volume 19

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TABLE OF CONTENTS

Cover Photograph

A resident in Ames High's biology lab for six weeks, this Screech Owl was caught in a garage by student Bernadine Sifrit. It had complete freedom in the lab. In daytime it lived in this hollow log section on top of a book case. At night it frequently perched on the head of a stuffed bald eagle. Photo by Richard Trump.

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Field Study to Challenge Biology Students[1]

FRANK P. FILICE
University of San Francisco

The biology course in high school has two, somewhat antagonistic, objectives. First, there is a real obligation to those students who are not going to major in college biology. These people must be made fit for a scientific age where intelligent living requires biological knowledge. Here the student must somehow be taught to make sound judgments concerning his personal health as well as to evaluate the varied and conflicting statements made about his own body through advertising media. The use of biological processes and controls in industries like food processing make it necessary for anyone in business to understand something of the principles that govern living things. Finally, today the citizen is more and more called upon to understand socially important aspects of biology that are being written into law, such as eugenics and conservation.

In order to make his way through the technological maze of our modern world the individual, then, must be given as much information about biological principles as is possible within the framework of the usual course at the educational level we are considering. Because this is true, the most efficient method is through the use of organized lectures. As such, field work must be relegated to the role of clarifying specific ideas covered in the lectures. They probably would most effectively take the form of trips to food processing plants, experimental stations and other areas where a single aspect of biology's impact on our lives is exemplified.

The teaching of biology at this secondary level, however, has a second objective of even greater importance. It has an obligation to those students who are to go on and major in one of the biological sciences. The teacher must discover those students with the talents necessary for success in this work and then stimulate them to go on. Now in this context the lecture method assumes considerably less value. As a matter of fact, the superficial treatment that is required in the ordinary high school is really a waste of time because the same ground must be covered again more profoundly at the college level. Instead of trying to give the student this sort of organized information, a much greater service can be performed if the biologically inclined student is discovered and then induced to develop the powers he may later use in the scientific method. In meeting this need, there is no technique that can replace the intelligent use of field work.

A true love of nature is the touchstone which can separate the potential biologist from all other students. To expect someone lacking this quality to become a biologist would be like asking a tone deaf student to become a musician. On the other hand, no one is a biologist without this pre-occupation with the natural world. After all, the biologist's primary purpose is to study nature in the field; those of us who work in the laboratory merely try to isolate a portion of the natural world in an area where we can conveniently attack it.

Anyone who has ever taken a group of unselected students into the field will recognize that there are some who spend their time worrying about the flies or the dust or whose conversation concerns only the cars that they see. But there are others who, sometimes to their own great surprise, enjoy every minute of the trip. They respond to the beauty of the landscape and are fascinated by how much can be seen in a wayside ditch. They wonder why one side of the hill is dry grassland while the other is dense with brush and trees. Usually these students have the potential to become our future biologists.

As a means of stimulating these future biologists to go on in their studies, field work has great value. It introduces the student to the ultimate reward that every scientist receives from his work, that is, the pleasure of

[1] Presented at the NABT meeting, American Institute of Biological Sciences program, Stanford University, August 25-29, 1957.

discovery. To find out something new by answering his own questions with his own effort is the type of stimulus needed to carry a student as far as his intelligence permits.

Finally, well constructed field experience can give a student the essentials of the scientific method. He can be taught to observe, and to assemble data from pertinent notes. He can learn to make assumptions and verify them by experiment or further observation. Further, there is a strong tendency to lead a student into the literature of science so that he can find solutions to some of the problems that arise. This is important because very few people can read and assimilate the material in a scientific paper without considerable training. Field work can also be used to correlate knowledge from many different fields like geology, taxonomy, limnology, meteorology.

Because of these important contributions the ideal secondary school course of biology should consist largely of field work. Such courses have proven very successful. An outstanding example of a course of this type is found at the Carmel High School in California. There the class spends most of its time in the field where the student is encouraged to ask questions about what he sees. He is then helped to work out the answers to those questions by means of literature and the experimental material needed to adequately tackle the problem.

Unfortunately, however, in most school systems it is impossible to segregate the college-potential students from those whose education will stop after high school has been completed. Consequently, the more usual high school course is a compromise between the lecture method, and field experience designed to stimulate the student and train him in the techniques of science. As a result of this compromise field work usually suffers. For example in some San Francisco High Schools no more than two or three field trips are taken in a program of 150 teaching days. In such circumstances the occasional field trip should be closely designed to give maximum benefit.

A well designed field excursion should have a definite aim such as collecting a certain group of animals or to demonstrate an important natural principle. The teacher should be thoroughly familiar with the area to be visited. It should contain the necessary biological phenomena to illustrate the objective he wishes to fulfill, and it should not be too far from the school. The class should be prepared for the trip. They should recognize the aims of the expedition and have available specimens of the more common animals and plants they will see. They should make an effort to learn the names of these forms so that they can discuss them intelligently in the field. It is true that this preview of the more common forms has very little value to the student since living things appear so different in their natural habitat than they do preserved in the laboratory. However, it does serve to focus the attention of the student and give him some known material from which to work. The class should be taught also to keep field notes and be given general reading about the type of biological community they are to observe.

On the excursion it is the teacher's job to stimulate observation by the students. By asking questions one can arouse curiosity in their minds as to the explanations of the phenomena they observe. It is helpful to parcel out different jobs to various groups of students. Map-making, pacing distances, collecting plants or animals are activities that serve to create interest in the student's mind. It is not wise to crowd too much into a single trip, but rather to attend to a few phenomena and bring out some of the hidden facts. The questions that arise in the course of the trip should not be answered by the teacher if at all possible. Instead he should assign the task of finding the answers to various students. They should solve the problems by going into the literature or by further observation and report later to the class.

A most important part of the trip is to bring back specimens for study in the class. Since living animals are much more interesting than dead specimens, this requires available vivaria. The specimens are necessary for protracted study of the animals to reveal facts that cannot be observed in the course of a short field trip.

In brief, the student reviews what he is going to see in the field before the trip. On the excursion his attention is focused on the phenomenon under study in its complex natural environment and he makes an attempt to analyze the complex picture into its components. Finally through a class report he draws together what he has learned through observation and reading.

There are, unfortunately, some school sys-

tems, especially in large cities, where the red tape involved in planning a field trip is so cumbersome that biology teachers soon learn to do without them. Even in this type of situation the student can receive adequate field experience. Here the teacher may survey all of the convenient natural areas in the vicinity of the school and note what biological materials or phenomena occur in each. Then groups of students can be assigned to visit these areas to collect specimens, to plot vegetation and so on. The report to the class then becomes an important part of the method and should be met with by questions by the other students as well as the teacher.

Under almost any classroom circumstance it is possibe to devise adequate field experience for the student with the objective of helping discover and train potential biologists.

Longer Life for Lizards

ROBERT G. HUDSON
The Pennsylvania S.P.C.A., Philadelphia

Within the past several years considerable information has been published on the care of live animals to aid the biology teacher or new pet owner. However, when one consults such works many are often found inadequate, usually lacking in specific information. Such a situation exists concerning the literature on maintenance of captive lizards. After collecting or purchasing healthy specimens one finds that gradually their vigor decreases until finally the animals succumb. This pattern appears consistently even though the lizards are eating and seem in good health. It is little consolation to note that such experiences were not restricted to the novice for it was a story retold many times in the reptile collections of zoological parks. Only recently have these institutions, through experimentation and the development of new techniques, achieved noteworthy longevity records for many saurians. The solution to long life appears to be threefold; involving a combination of temperature, humidity and a variety of diet.

Optimum temperatures for most reptiles are still unknown but experimentation with heat lamps, used for short periods of time, has proved them to be of definite value. Such lights usually stimulate feeding and increase activity, both of which are conducive to long life. Some lizards will bask directly under the lights and then dig down into the warm sand or floor litter at night when the lights are off.

In order to reduce the amount of moisture within the lizard enclosure it has been found advisable to introduce only those plants requiring infrequent watering. A variety of cacti in a desert type terrarium is an ideal arrangement. The sprinkling of water on the glass sides or plants for drinking purposes should be infrequent for the food eaten usually supplies the necessary moisture requirements.

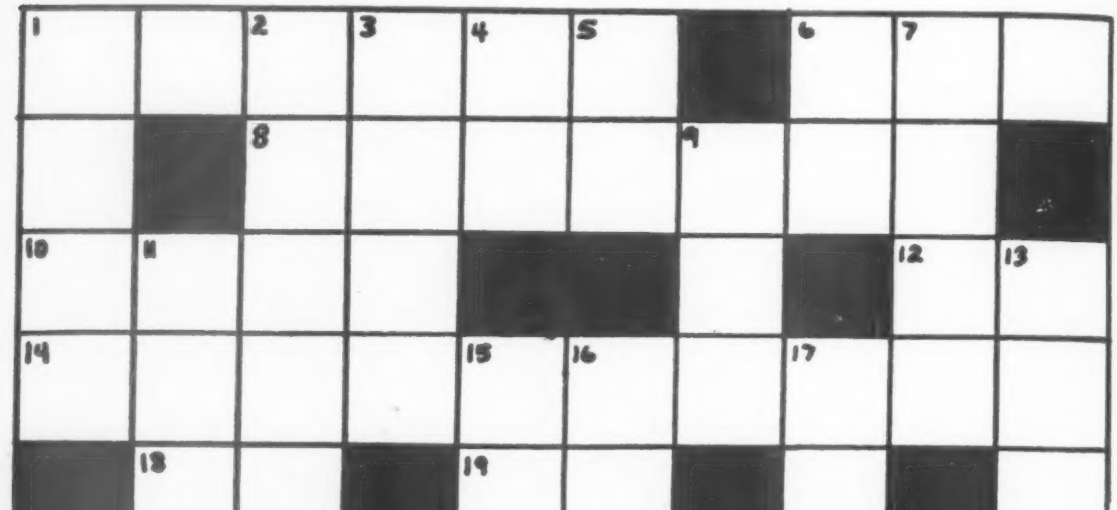
The feeding of a particular type of food, invariably meal worms, has been responsible for many lizard deaths. It should be recognized that a variety of insects is essential. If insect cultures are not maintained during the critical winter months a supplementary mixture of raw egg, finely ground meat and vitamins is often accepted with relish by most forms. One's ingenuity is often rewarded for some lizards will thrive on a diet that is completely foreign to their natural fare. An outstanding example of this has been reported of Carolina Anoles (*Anolis c. carolinensis*), also incorrectly called "Chameleons," feeding upon grated carrots, honey with pulverized nuts, guava jelly, lettuce cut into slivers, chocolate cake icing and cake crumbs, raw meat, commercial turtle food, softened cereal, milk and soaked dog biscuit. Care should be taken not to feed excessively for some lizards tend to get overweight with fatal results.

In the area of amateur research, studies of captive lizards offer a fertile field for contributions on the life-history of these animals. The three factors discussed in this account still need considerable elaboration. The teacher, student and pet owner will find detailed observations of lizards to be a rewarding activity, for one soon reaches the conclusion that here is a most interesting reptile.

Biology Crossword Puzzle

T. G. OVERMIRE
Shortridge High School, Indianapolis, Indiana.

The day before school is out for the Christmas holidays is frequently a long one for the teacher! This crossword puzzle is one solution to this problem day.



ACROSS

1. Study of plants
6. Sounds like eight
8. Is part plant, part animal
10. Where is your biology book?
12. Do we get out of school early today?
14. Study of insects
18. Opposite of "ain't"
19. You and me
20. Leave
21. A fungus that attacks corn
22. Not out

ACROSS *(Continued)*

23. A corporal or a sergeant
24. Cool, man, cool! !
26. Aquatic mammals
28. Abbreviation for corner
30. Old MacDonald had a farm - - - - .
32. Number one on the Christmas hit parade
33. Watch for him this month.

DOWN

1. Stored in the gall bladder
2. A whole vacation without them!
3. An old-fashioned car
4. Nicolastus Geiseldephe's nickname
5. A bright color (abbreviated)
6. One
7. A sharp taste (backwards it is a small fly)
9. A slippery guy with a large charge
11. Good cells for microscopic study (lily family)
13. A mollusk
15. Helps you move
16. How does water get into a root?
17. Name of the nerve to the eye
20. What your doctor calls the "gastro-intestinal" tract
23. An "emergency" source of iron in the diet
25. Mud hen
27. A mistake (in Morse code)
29. Not off
31. The fifteenth and first letters

Solution to Puzzle on page 245

A Study of Control Grouping in High School Biology

EDWIN E. WHEELER, *Counselor and* THOMAS A. BASS, *Teacher of Biology*
Port Neches-Groves High School
Port Neches, Texas

The many ramifications inherent in the increasing enrollment in our high school, as well as those over the nation, have prompted many school officials to ponder solutions that would allow them to seat and properly educate this mass of pupils. The present size of our school with regard to incoming students is sufficient to safely allow us seating space, but the intellectual attainment of these students has been a constant source of challenge to each of us here. We made this study on grouped biology classes as just one phase of an increasing awareness of the proper utilization of the abilities of our students.

Purpose: We will attempt to determine six points in this paper with regard to individual achievement and teaching efficiency. The points to be considered are:

1. the achievement of subject matter mastery over the year for both groups,
2. the achievement difference in subject matter mastery for the two controlled groups, and if this differential increase is statistically sound,
3. the benefits, through a greater learning situation, to the select group,
4. the benefits of grouping to the control group,
5. the feasibility of control grouping on the basis of an earned grade average,
6. and finally, justification of the time and effort on the part of the teacher and administration by an increased learning situation.

Method and Procedure:

Biology is a more or less required course in Port Neches-Groves High School as two years of science are required for graduation. The two courses normally taken to satisfy this requirement are general science, in the junior high ninth grade, and biology in the tenth grade of senior high. We used the earned mark in general science as the criteria for inclusion in the "special" biology class. There were forty-six students selected for grouping. An attempt was made to equate the grouping into two classes, but no inflexible plan was adopted. We attempted to place an equal number of boys and girls in each class. Classes were scheduled so that a select and control class met in the morning, with the same being true of afternoon classes. This gave us a total of two select groups and two control groups.

We selected the *Nelson Biology Test* to

use as the standardized method of tested achievement. The four groups were tested on their knowledge of biology the first week of school and then retested the last week. We used the *Otis Test of Mental Ability* for their scholastic aptitude as this test is one used on the expectancy chart for the Nelson Test. In an effort to keep all inconsistencies to a minimum, the counselor conducted all testing.

Results:

We will attempt to answer the question of subject matter achievement first, using the calculated 5-score to test the null hypothesis for each of the two groups for the control as well as the select group. The mean of the select group at the first of the year was 105 (standard score) and at the end of the year was 120.2. Computation gave us a t-score of 7.76 which is too great a number to read on the table, so for the select group we can reject the null hypothesis with confidence. The possibility of the laws of chance operating in the achieved differences of the select group is nil. Computing the t-score of the control group, we find a mean of 93.96 for the first test and 103.73 for the second. This gives us a t-score of 3.96, or approximately 634 out of 10,000,000 cases that the laws of chance are operative.

Table I will show the data to be used in determining the differential achievement of the select and control group. We have chosen the five centile points of 10th, 25th, 50th, 75th and 90th as these should show the distribution of the group. The select group is approximately 17 standard score points ahead of the control group at the 10th, 25th, and 50th centile, and then maintains around a 12 score point lead at the 75th, and a 9 point lead at the 90th centile. The difference is statistically sound as a t-score of 6.27 was computed on the two groups. This allows us to reject the null hypothesis with confidence.

Table II will give us information for the hypothesis of more achievement for the select students when grouped. Careful perusal of the data presented will reveal the fact that the select group is ahead at all centile points. The smallest difference is at the 10th centile, being 14 points, and the greatest difference is about 17 points at the first quartile. The

TABLE I

Comparison of the Control Groups on the Nelson Biology Test at Selected Centile Positions.

	P_{10}	Q_1	Mdn	Q_3	P_{90}
Select Group	108.4	112.9	120.0	128.5	135.4
Control Group	87.7	94.2	103.3	116.0	126.0

TABLE II

Comparison of the Selective Group in Biology and the National Standardization Group on the Nelson Biology Test.

PN-G	P_{10}	Q_1	Mdn	Q_3	P_{90}
Select	108.4	112.9	120.0	128.5	135.4
National	86.5	95.3	104.0	113.0	121.5

TABLE III

Comparison of the Control Group in Biology and the National Standardization Group on the Nelson Biology Test.

PN-G	P_{10}	Q_1	Mdn	Q_3	P_{90}
Control	87.7	94.2	103.3	116.0	126.0
National	86.5	95.3	104.0	113.0	121.5

median score of this group has a standard score of 120, which converted to national norms is the 88th centile, and the score of the select group at the 90th centile is comparable to the 99th centile nationally.

The determination of whether or not the grouping was beneficial to the control as well as the select group can partially be found in Table III. The 25th and 50th centiles find the control group about one score point behind the national group, but they are ahead at the 10th (by one), the 75th (three), and over four at the 90th centile. This comparison at the upper ten per cent level finds the control group achieving between the 94th and 95th centiles on national norms. The top students in the control group tended to rescramble in vying for the academic leadership after the other group was removed from the competition.

We found that teacher's marks are not necessarily the best index to use for grouping as their subjectivity is too great. In double checking scores of other students on the *Nelson Biology Test*, their achievement test scores in the ninth grade, and their intelligence quotient, we feel that grouping on these three indices is superior to the single criteria.

The last hypothesis, with reference to time spent by all concerned, indicates that the grouping was considered worthwhile by teacher, principal, and counselor. We can therefore look forward to greater academic accomplishments in the years to come.

Summary and Conclusions:

The study of grouping has added materially to the improvement of our science offerings and also to the counseling service. These select students have utilized the services of their instructor and counselor much more than any group of previous sophomores. The statistical analysis presented in the body of this paper seems to be proof of our desired goals and we feel that no damage was done to either group in a social situation. There were no feelings of superiority or inferiority expressed by either group, at least to the knowledge of the faculty or administration.

Solution to Puzzle on page 242

B	O	T	A	N	Y		A	T	E
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A four (4) page periodical, published twice a month, called "Your Future Occupation," may be obtained from the Randall Publishing Company, 2970 Mills Avenue, NE, Washington 18, D. C. This publication has as its aim the providing of accurate, current information on job opportunities, training, and career guidance.

Biology at the Population Level*

DONALD E. WOHLSCHLAG
Department of Biological Sciences, Stanford University

The necessity of emphasizing biological studies at the population level on both theoretical and practical grounds is apparent simply because both animals and plants exist naturally in populations. The need for such studies is especially important for an understanding of the effects of exploiting biological resources and for predicting sustained maximum yields from these resources.

Before studies on populations can be made and the results interpreted, the structure of the populations in question must be defined in terms of a discrete group of organisms occurring within definite spacial confines. All biological and statistical information pertaining to the organisms as individuals and as populations must be marshalled for such a definition.

Once a population is defined its functions may be studied in terms of rates of change or "dynamics." To pursue a study of population dynamics so that population changes can be understood, it is essential that population size, rates of increase (birth, growth, recruitment, and immigration), and rates of decrease (natural mortality, exploitation, and emigration) be investigated. Some of the simpler biological, statistical, and mathematical procedures for obtaining this essential information are discussed with reference to the construction of pertinent mathematical and statistical population models which may be applied to the populations under study.

That the construction and interpretation of models be better understood, illustrations are given for their application to experimental and actual populations.

(1) The application of mark-and-recapture techniques for the estimation of population size is shown.

*Abstract of a paper presented to the National Association of Biology Teachers Session at the American Institute of Biological Sciences National Meetings. August 26, 1957.

(2) Results of experimental studies are given to indicate the nature of unstable populations which tend to fluctuate in regular cycles.

(3) An example of a hypothetical fish population with a constant birth (or recruitment) rate and with constant natural mortality and growth rates is examined for effects of doubling the rate of exploitation. It is shown that the stable population size becomes reduced to two-thirds its original size, and consists of younger and smaller fish, that the catch doubles in the first year of the doubled exploitation but eventually is only one-third greater in numbers and only two-thirds in weight of the original catch, and that three times the fishing effort is eventually required to maintain even this decreased yield.

(4) Another example is given to illustrate the computation of minimum size limits of exploited organisms so that maximum yields may be obtained under different rates of exploitation; this example illustrates a simple method of combining information on population size with information on rates of change due to growth and to natural and exploitation mortality.

The universal applicability of these models to all kinds of plant and animal population is emphasized.

During the past few decades there has been a great advance in the mathematical and statistical theory of population dynamics although biological application has been lagging by two to three decades. Many more biologists with broader backgrounds in mathematical fields are needed to close this gap.

Disinterest in Biology—An Answer?

ROBERT BARLOW
Ewing Junior High School, Trenton, New Jersey

The archaic insistence that the major portion of a biology course must concern botanical and zoological taxonomy as well as masses of information on lower vertebrates and invertebrates has cost, and will continue to cost us, a substantial loss of possible enrollees.

In what way does the average student benefit by knowing the members of the Elasmobranchii? Knowledge for the sake of knowing is a worthy ideal, but, let's face it, a course in any secondary school subject should be composed of material most likely to benefit the larger group that choose bio-medical fields of work. Despite its limited appeal, taxonomy is still the apparent favorite of some teachers.

The problem arises from the fact that biology today is an elective course in many schools. Students are electing not to become involved in work of that nature.

Webster's Dictionary defines biology as "the science of living organisms." In our studious concern with the plant and animal worlds, we may neglect the study of the human animal and his problems. Some of you will say quickly, "Health classes take care of that." My answer—why should they! In the study of human physiology and anatomy, chronic and communicable diseases, and medical therapeutics, you have possibly the area of greatest general interest. Nearly all children like to know why or how they tick. Many, many stories of discoveries in medical science rank with the best material science fiction has produced or equal the best mysteries and suspense stories literature has produced.

High school is terminal for most students. A knowledge of such items as basic adult psychology and physiology, the epidemiology of certain important common diseases, and modern advances in medical treatments and techniques will be invaluable to these students as adults. Material of this kind would do much to correct the mass of misinformation as well as the lack of information of human physiology and modern medicine prevalent among much of the lay populace as well as the students themselves. A biology course containing that information would be the only pre-adult time that the students would be exposed to it.

In my experience, health students may be exposed to little information on a topic such as a disease to any depth beyond a discussion of symptoms and suggestions as to how to avoid the disease. This may be due to several factors such as: 1) a course of study that

permits no time for digressions, 2) personal inadequacies in teacher preparation, such as insufficient science background, 3) lack of teacher interest.

The fact that the public sees a clear distinction between the content of health and biology courses was brought forceably to my attention recently. I wrote some fifty major companies working in the pharmaceuticals, biologicals, and allied fields inquiring as to the materials they had available that might be useful to teachers of general science in biologically-oriented units and to teachers of biology in their course work. While many wrote of such materials, a considerable minority said that they had no material suitable for biology or similarly oriented units. However, many of that group forwarded materials that were "suitable for health classes" with a note they doubted their suitability for biology courses. On examination I found that virtually all of the visual aids could be used in any unit relating to human anatomy, physiology, or public health either in general science or in biology. If people working in the field have difficulty making the distinction between health and biology, I am led to wonder how much material is not taught by health teachers in the feeling that it will be taught in biology courses, and how much material is never taught by biology or general science teachers.

What is needed is a closer definition and correlation of the areas which health and biology are to cover on a given topic or area of study. There is no reason why health courses cannot discuss how to avoid or how to care for a certain illness and the biology courses discuss the causative agent of said disease, the manner in which a disease spreads, and the manner in which a disease is controlled or cured. By such division of labor, the student receives a complete overview of a section of science. The fault that an overview of this kind is infrequent lies in lack of definition of teacher responsibilities.

In the concern with taxonomy and with its animal and plant aspects, the biology teacher is often prone to slur over, or possibly omit, a section of biology that holds great student interest and is readily taught with a minimum of material; that is, human, animal, and plant genetics. The subject is often superficially treated in the text.

Last year I taught general science to a high I.Q. eighth grade class. The prescribed course of study was finished several weeks early. To fill in the remaining time I asked the students to select the areas of science they would like to study. Although there was a wide range of choices, the largest number specified genetics as their first choice. My biggest handicap was lack of suitable printed text or reference material for student use. They had to rely on lectures and dittoed worksheets and charts as the unit developed. Despite that problem we were able to develop such concepts as gene, chromosome, dominance and recessiveness, incomplete and irregular dominance, and sex-linkage. In our final topic of study we discussed the mechanism of inheritance (dominant etc.) of specific disease conditions as well as specific mental and physical traits and abnormalities. After that we attempted to predict the outcome (via genetic checkerboards) of animal or plant matings. I do not claim that they are now conversant with the field of genetics. I do say that the major portion of the group thoroughly enjoyed and participated in the studies. The best evidence of this is the fact that most (about 70%) students selected this unit as most interesting and valuable of all those studied.

The study of genetics need not be restricted to the highly intelligent groups. To investigate this thesis, I conducted a similar concurrently-run unit with a low intelligence group. Much the same material was covered but far less rigorously than in the superior group. There were more difficulties encountered, primarily those of difficulty in understanding complex concepts. This unit required more work on my part than did the other. Results in student learning and interest were as satisfactory as the results in the high I.Q. group.

I am suggesting that our present biology courses often meet neither the needs nor the interests of the majority of students. As a result we do not reach our potential audience of students. My suggested partial remedy, not a panacea, is alteration of present courses to emphasize more human biology. Such an emphasis or expansion need not conflict with the work of the health teachers, indeed should supplement it.

Breeding Drosophila in Disposable Paper Containers

LLOYD L. ARNOLD II
Assistant Professor of Natural Science, Loyola University, Chicago, Illinois.

A container in use showing the medium and the flies visible through the cover. The rolled lip or cuff which insures this "fly-tight" closure can be seen in the cross-sectioned container above.

The container cover with disc parts removed and the transparent film in place over the ring ready to be fitted to a container.

This is a method by which *Drosophila* may be bred and nurtured in plastic-lined paper containers (such as cottage cheese and ice-cream are packed in) using nothing more formidable in the way of equipment than a two-quart saucepan in which to prepare the medium, and dispensing entirely with the odious and expensive labor of washing fly bottles.

This technique will have its most immediate appeal to the biologist in a small college or high school who has hesitated to introduce the laboratory study of genetics because of the considerable outlay in sterilizing equipment and glassware which would be in use for a relatively short time each year. In practice, however, this technique has exposed a further dimension of easy fruit fly study, the full possibilities of which we are only beginning to appreciate.

When in use the containers are covered by a window of clear plastic film which leaves the entire exposed surface of the medium and the chamber above it open to undistorted observation. The flies can, therefore, be observed throughout their lives, either directly or with the aid of a dissection microscope, without removing the cover. Embryonic and larval forms are as easily studied as the adult forms. This makes it possible to undertake, almost casually, studies that hitherto involved elaborate and expensive procedures. For ex-

ample, by the simple expedient of counting eggs, we can predict and regulate the population of a culture, and in the same way, we can study problems of fertility and fecundity. We have found this technique particularly useful in studying the aging process in *Drosophila* since it minimizes the amount of handling that the flies must sustain in a lifetime of being scrutinized.

The Containers

We found that the 8 oz. plastic-lined "Nestyle"[1] container was best suited for our purposes. Fly medium seems to retain its moisture about as well in these containers as it does in conventional ½ pt. glass bottles and they are sufficiently sturdy that they can be autoclaved either before or after filling. The containers are practically sterile when they arrive from the manufacturer, however, and with our present medium we have dispensed with autoclaving entirely.

These are round containers with slightly tapered walls designed to be shipped and stored nested one inside the next. They are about 45 mm. deep with an inside diameter at the top of 82 mm. and at the bottom of 76 mm. The feature which particularly recommends the "Nestyle" container for our purposes is the fact that the lip is rolled outwards and down to form a cuff about 3 mm. thick and 9 mm. wide around the top of the container. This cuff is sufficiently resilient to make a firm closure with the cover, even after considerable use. We have never lost any flies due to loosened covers from containers of this type.

These containers are supplied with a hood type cover which consists of a paper board ring or hoop about 20 mm. high which fits down snugly over the outside of the cuffed lip, and two paper board discs which are folded into the top edge of the ring and cover the mouth of the container.

As soon as the medium has been poured we put on these covers and store the containers in the refrigerator. We have found it convenient to write or stamp the date on the top of this cover. We avoid using medium over two weeks old, but we have on occasion used medium well over a month old with reasonably satisfactory results.

When flies are to be introduced, by a procedure to be described later, the disc parts of the cover are pushed out and discarded; a sheet of clear plastic film ("Saran Wrap")[2] is placed over the container and the ring is put back on to hold it in place. After the ring is in place the film can still be pulled out flat, and when this is done it will be almost completely transparent; there is no distortion and practically no reflection.

When we began using these containers, occasionally the medium would pull loose from the walls of the container and fall out while we were shaking out the flies. However, we found that this could be easily prevented by putting a small gauze anchor in the bottom of the container. This anchor consists of a strip of one-inch gauze bandage about 3″ long which is attached across the bottom by a drop of "Duco" cement at each end. By putting a half turn in this gauze strip, a loose loop is thus formed which will not be flattened by the hot medium and will hold the hardened medium quite firmly. When we are through with our cultures, we simply incinerate the containers by throwing them in the furnace.

The Medium

We use a modification of the formula reported by Carpenter (1950)[3], and our formulary reads as follows:

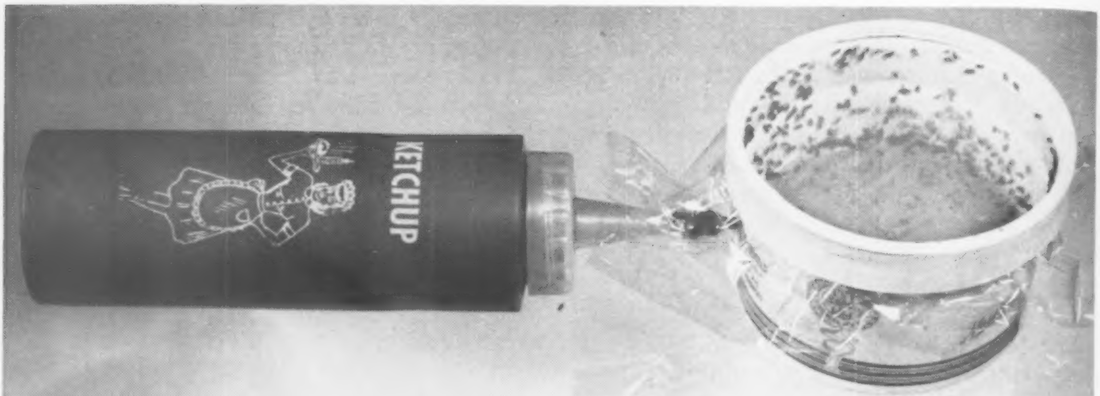
Solution A.		*Solution B.*	
Water	900 ml.	Water	200 ml.
Agar	15 gm.	Potassium and Sodium tartrate	8 gm.
Brewer's Yeast	50 gm.	Calcium Chloride	0.5 gm.
Sucrose	100 gm.	Manganous Chloride	0.5 gm.
Potassium Phosphate (Monobasic)	1 gm.	Ferrous sulfate	0.5 gm.

1. To 900 ml. of rapidly boiling water slowly add the previously mixed dry ingredients of Solution A, and cook for 10 minutes stirring frequently to avoid sticking.

[1]Manufactured by the Sealright Company, Fulton, N.Y.

[2]Made by the Dow Chemical Co.

[3]Carpenter, J. M.: New synthetic food medium for Drosophila. Drosophila Information Service #24: 96-97, 1950.



A container of flies ready for anesthesia. The "ketchup" bottle at left contains one or two facial tissues wet with ether and the hypodermic needle fitted to the spout punctures the wall of the container and, when the bottle is squeezed, admits ether-laden air to the container.

2. Remove from heat and add Solution B.
3. Allow the medium to cool a few minutes and add 5 ml. Propionic acid.
4. Pour medium into containers to a depth of ½ in. or so (*ca 50 cc.*); this yields 20 containers per batch of medium.
5. Close with regular container cover, and store in the refrigerator.

As indicated earlier, we have dispensed with autoclaving entirely. Our medium is prepared in a saucepan over an electric hot plate and poured directly into the containers. In the six months we have been using this technique not a single culture has been contaminated by mold, and the few instances of serious bacterial invasion, have occurred in old cultures after the first generation flies had all emerged.

Etherizing

We have found that it is most convenient to anesthetize the flies by suffusing their containers with ether-laden air before opening them. We have developed for this purpose a simple anesthesia machine, which consists of a polyethylene catsup bottle to the nozzle of which is fitted an hypodermic needle. Historically, it began as a needle with which we toured the 10¢ stores looking for a polyethylene vessel to which it could be fitted. Inside the bottle are two or three facial tissues saturated with ether. The bottle serves as a bellows and the needle pierces the wall of the container to admit gaseous ether. The tissues not only increase the surface area of the ether and facilitate its evaporation but they also confine the liquid ether to the bellows and thereby prevent the inadvertent spraying of the flies. The only critical item here is the needle size; needles larger than #20 make holes big enough for flies to crawl through. The shorter the needle, the easier it is to handle. The machine holds sufficient ether for dozens of containers and in fairly light service need not be filled every day, since very little ether escapes when the machine is not in use.

The procedure is this: The container is held on its side (or upside down) so that the anesthetized flies will not fall into the medium. It also helps to tap the container gently as the ether is being introduced, to make doubly sure that the anesthetized flies fall away from the medium. The wall of the container is then pierced with the needle somewhere between the medium and the cover and a measure of ether-laden air is pumped into the chamber. This should be done slowly to prevent blowing off the cover or damaging the flies. We have experimented with putting a separate air intake in the bellows, but we found that the simplest and most effective procedure is to recirculate the air back and forth between the bellows and the container by alternately squeezing and releasing until the flies are immobilized. This gives a greater concentration of ether in the chamber and less escapes into the general atmosphere.

Over-etherization can easily be avoided if

the etherizing is stopped as soon as the great majority of flies have succumbed and in a minute or so all of the flies will be immobilized. The container is then placed face down on the table, preferably in a large paper plate, and tapped gently to dislodge any flies clinging to the sides or the medium; the cover (the plastic film and the paper board ring) is held down firmly on the table and the body of the container is gently removed. If this is done carefully, the flies will all be confined to the cover. Any flies that remain stuck to the wall of the container or to the medium can be removed with a camel's hair brush.

New Cultures

The study of any problem may require some special technical modifications or innovations which are of limited application. For our aging studies we have developed several of these, but the routine procedure followed in setting up new stock cultures seems to be of sufficient general interest to merit reporting.

1. The required number of containers is removed from the refrigerator and allowed to reach room temperature. This not only shortens recovery time but also reduces the number of flies that do not survive anesthesia.
2. The breeding stock is anesthetized, as previously described, and the flies to be used in the new culture are selected.
3. The top is removed from a new container, the medium is sprinkled lightly with viable dried yeast, and the container is placed face down on the table. (A kitchen-type salt shaker makes an excellent dispenser for dried yeast.)
4. The disc parts of the cover are pushed out and discarded.
5. The ring is placed top down in the center of a paper plate and a square of clear plastic film ("Saran Wrap" *ca.* 6x6") is placed over it.
6. The previously selected flies for the new culture are placed in the center of the film and the body of the container is pressed down over the flies and into the ring.
7. The date and other pertinent data is entered on the bottom of the container.
8. The container is left face down or on its side until the flies have recovered sufficiently to avoid getting stuck in the medium, and a dozen or so holes are punched in the film with a sharp needle to assure adequate ventilation.

When the flies have recovered, the containers are placed in trays which are made by cutting the tops off pasteboard cartons of convenient size so as to leave a shallow box formed from the sides and bottom, and about $\frac{3}{4}$" deeper than the height of the container. These trays are then stacked irregularly so as to assure adequate ventilation and are placed on shelves to conserve space.

Summary

This paper describes a simpler method of dealing with fruitflies, including their breeding, observation and anesthetization, by the use of plastic-lined paper containers. The main advantages of the technic are a) that they are more economical than glass bottles, b) are disposable, and c) require no sterilizing equipment. A further great advantage is that the larvae and flies are open to undistorted observation at all times, either by the naked eye or through a dissection microscope.

Books for Biologists

HEREDITY AND YOUR LIFE, A. M. Winchester, 333 pp., $5.00, Vantage Press, Inc., New York 1, New York, 1956.

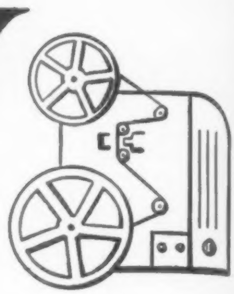
This timely, informative book gives the reader authoritative background on tomorrow's news in the field of genetics. It is shown how ancient beliefs concerning heredity are related to superstitions of today. This well-known expert on genetics then brings out the vital features of current knowledge of this field and tells how it may be applied. The emphasis placed upon the genes as units of heredity are discussed in the light of disease resistance, intellectual capacity, pedigrees, marriage, parentage, sex and the effects of radiation and the atomic age.

(See ad on page 236)

A TEXTBOOK OF ENTOMOLOGY, Herbert H. Ross, 519 pp., $7.75, John Wiley and Sons, Inc., New York 16, N. Y., 1956.

This book provides a broad suvey of the basic fields of entomology–including morphology, physiology, taxonomy, and ecology. The book is amply illustrated and contains new keys to the ordes of insects.

A-V NEWS



EMERY L. WILL, Head Science Department
State University Teachers College, Oneonta, N. Y.

Following are descriptions of some new classroom films in the biological sciences, which were selected for showing at the NABT meetings in Indianapolis on December 27-28. This year, most selections were made for consideration at the junior-senior high school and college levels. In our opinion, all of them rate very high among the films produced during this past year, and each one has some particular merit. By the way, when you run across audio-visual materials that really suit your needs, why not write an approving note to the producers, so they will know how you react to their products? We'd like to know too.

The Ladybird Story. 11 min., sd., color, upper elementary and junior high. How the Vedalia ladybird bettle was selected to control the cottony-cushion scale, which had been ruining California citrus groves. Particularly valuable in recounting scientific procedures in the biological control of insect pests; stimulates objective thinking in problem solving. Pat Dowling Pictures, 1056 S. Robertson Blvd., Los Angeles 35, Calif.

How Living Things Change. 11 min., sd., color, junior-senior high. Evidences of gradual change in plant and animal forms through millions of years, accompanied by the most noteworthy explanations advanced for the changes. Lamarck's theory of acquired characteristics, Darwin's idea of natural selection, and DeVries' observations on mutations are illustrated and analyzed simply and effectively. Coronet Instructional Films, 65 E. So. Water St., Chicago 1, Ill.

Adelie Penguins of the Antarctic. 20 min., sd., color, senior high, college and general audiences. The first complete record of any penguin on film, this is a remarkable scientific document, making excellent use of dramatic life episodes and amusing charm of its penguin subjects. In addition to its providing a fine study of animal behavior, the film introduces the many environmental factors encountered in the Antarctic habitat. This life history film sets a new standard for excellence. Produced by the New York Zoological Society; distributed by McGraw-Hill Book Company, Text-Film Division, 330 West 42nd St., New York 36, N. Y.

A Piece of Wood. 15 min., sd., color, junior-senior high and general audiences. An absorbing, instructive account of the scientific research conducted at the USDA Forest Service's Forest Products Laboratory at Madison, Wisconsin. Through basic research on wood, it becomes possible to develop new and better uses of forest products. New sources of pulp, better drying methods, improved preservatives, use of waste products from sawmills, and the development of powerful laminated arches are among the topics so well treated in this film. Motion Picture Service, U. S. Department of Agriculture, Washington 25, D. C.

Protozoa. 11 min., sd., color, senior high and college. Featuring unusually fine scenes of movement, feeding and reproduction, this is an excellent classroom study of the protozoa. In covering the pseudopods, flagellates and ciliates, the film includes illustrations of colonialism, symbiosis and parasitism. It is a well organized, challenging presentation. Encyclopaedia Britannica Films, Inc., 1125 Central Ave., Wilmette, Ill.

Index for Volume 19

Compiled by John D. Woolever
Sarasota High School, Sarasota, Florida

By Subject

By Authors

Books for Biologists

BOOK REVIEWS

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